SRNL
Savannah River National Laboratory
factsheets

CORE COMPETENCY

Materials Science

Overview

Materials scientists and engineers at SRNL play a key role in many critical missions in the area of national security, environmental management and energy applications throughout the DOE complex. They also provide unique services to other federal agencies and private industry. The SRNL materials technology expertise is focused on developing and advancing new materials and processes; characterizing materials structure, properties and performance; and establishing the safety and reliability of the systems and components.

Dr. Elliott Clark has extensive research experience in metallurgical engineering and materials science with an emphasis on systems that contain and handle tritium, especially hydride storage materials. He is currently studying the effects of tritium on polymers.

Materials Selection and Characterization

SRNL materials technologies provide resources to characterize, identify, test, and evaluate materials and their response to highly aggressive, specific chemical and radiological service environments. Capabilities that support materials characterization include:

- Scanning Transmission and Scanning Electron Microscopy, including a glovebox-contained system for highly radioactive materials, and an environmental unit for in-situ, real-time materials response characterization
- Atomic Force Microscopy, Auger Spectroscopy, Raman Spectroscopy and FTIR spectroscopy
- Particulate Characterization including size and surface area analysis
- X-ray diffraction, X-ray fluorescence for both non-radioactive and radioactive applications
- Mechanical Properties Characterization including tensile, fatigue, creep and fracture mechanics properties of metals, ceramics and polymers

Ceramics Technology

Ceramics technology provides a versatile method for immobilizing, neutralizing and recycling a variety of nuclear and hazardous waste streams. SRNL has glass scientists and ceramists with world-class credentials. They have conducted extensive analysis of the behavior, in glass and ceramics, of nearly every element in the Periodic Table. This has enabled SRNL to provide solutions for a broad range of issues, such as:

- Creating the appropriate formulations for hazardous waste management and immobilization
- Employing vitrification and ceramic fabrication techniques for immobilizing highly radioactive wastes.
- Building and operating the world's largest radioactive waste glassification plant
- Developing nuclear ceramic heat sources for deep space missions
- Developing sol gel technology for fuels and other applications

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Materials Science

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Materials Performance, Corrosion and Service Life Prediction

SRNL has developed comprehensive expertise characterizing the corrosion and performance of materials in the harsh environments common to hazardous chemical and nuclear operations. Leading-edge expertise to enable materials performance evaluation include:

- Performance and Compatibility Testing including analysis of effects of service environment (chemicals, radiation, applied stress, pressure, and temperature), and analysis of hydrogen isotope effects on materials. State-of-the-art testing and sensing techniques are used to assess performance issues related to metals/alloys, glass, ceramics, and polymers employed in nuclear and industrial operations. Customized pilot scale systems are also often developed to evaluate materials/systems performance in order to validate safety bases.
- Service Life Extension models to analyze materials and components to characterize their life cycle performances. This information is integrated into life prediction models to provide bases for materials and/or component life extension.
- Nondestructive Examination and In-Service Inspection where SRNL engineers apply state-of-the-art non-destructive examination techniques based on digital radiography, ultrasonics, eddy current, etc. to monitor integrity of components, systems, and structures and validate life prediction models.

Kerry Dunn played an important role in developing a surveillance program for specialized canisters to ensure safe, long-term storage of plutonium. She also led a project which studied the effects of material degradation on tritium storage vessels and established limits for the safe use of reservoirs.

Materials Processing and Prototyping

SRNL has developed a unique capability in the processing and joining of materials including metals, ceramics, and polymers for both non-nuclear and nuclear materials. SRNL has also been the DOE leader in the development and deployment of closure welding technologies for all types of nuclear materials packages. The materials processing laboratory, a 20,000 sq. ft. high-bay area, includes comprehensive capabilities to fabricate metallic and composite materials with conventional metalworking, powder metallurgy, etc. It also has capabilities in materials joining, including brazing and welding.

Failure Analysis and Prevention

SRNL has a unique combination of technical expertise and facilities to provide thorough and accurate failure analyses on a 24/7 service basis. SRNL has the comprehensive suite of tools including computer modeling, materials characterization, and field characterization equipment needed for diagnosis and analysis of failures and to develop recommendations for failure prevention.

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